The Pennsylvania State College
Agricultural Experiment Station

BULLETIN NO. 66

Spraying Grapes for Black Rot in Erie County, Penna.

STATE COLLEGE,
CENTRE COUNTY, PENNSYLVANIA.

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THE PENNSYLVANIA STATE COLLEGE AGRICULTURAL EXPERIMENT STATION

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BULLETIN NO. 66

Spraying Grapes for Black Rot in Erie County, Pennsylvania.

BY GEO. C. BUTZ.

In the season of 1902 a considerable number of vineyards in the western end of the famous Chautauqua Grape Belt were visited by the fungous disease known as Black Rot to such an extent that some vineyards are reported as having sustained a loss of one-fourth to one-half of their crop. A few alert grape growers who are somewhat familiar with the experience of vineyardists in Ohio where vast areas of once profitable vines are being reported as totally neglected because of the destruction occasioned by the Black Rot, sounded the note of alarm among the grape growers of Erie Co., Pa., and called them together in conferences to consider methods of future protection against this foe of their great industry. After consulting together it was decided to appeal to the State Legislature for a small appropriation of money to enable the Experiment Station to conduct spraying experiments in the vineyards of Erie county and otherwise assist the grape growers in protecting their crop against loss by fungous diseases and insect enemies. The appropriation was not granted and the time for the active warfare of a new season was close at hand. Assistance was then solicited from the Secretary of Agriculture who met the grape growers at Northeast, Pa., on May 5th, 1903, having called to the conference Prof. H. A. Surface, economic zoologist of the Department of Agriculture, Prof. Geo. C. Butz, Horticulturist of the Experiment Station, State College, Pa., and also Mr. John F. Hicks, of the Ohio Experiment Station, be-

cause of his experience in the vineyards of Ohio. The situation was thoroughly discussed and, in view of the fact that neither the Department of Agriculture nor the Experiment Station had funds available for extensive spraying operations, several progressive fruit growers agreed to provide themselves with suitable spraying apparatus and materials and to spray their vineyards faithfully if they could expect expert supervision and direction as the work of the season progressed. This proposition was accepted and approved and Prof. Geo. C. Butz, Horticulturist of the Experiment Station, was put in charge of the work.

While it was impossible for the writer to spend much time in the vineyards or to be present when the sprayers were operating, the results of the season's operations indicate that thorough work was done and that fungicides when properly applied will prevent the attack of Black Rot upon grapes.

THE ERIE COUNTY GRAPE DISTRICT.

The growing of grapes in Pennsylvania on a commercial scale is almost wholly concentrated in Erie county or that portion of the State bordering on Lake Erie. The census Report of 1900 shows Pennsylvania to stand fourth in the list of grape producing States, the crop of 1899 being estimated at 47,125,437 pounds. About two-thirds of the crop, or 31,648,022 pounds were grown in Erie county. A closer investigation reveals the fact that the great vineyard district is restricted to a narrow strip of land not over four miles wide and extending along the southern shore of the lake from Harbor creek eastward to the New York State line, where it is contiguous with a similar district in New York, with which it forms the Chautauqua Grape Belt. Over 4000 acres of grapes are in Northeast Township, in Erie county, Pa.

The grapes grown in this district are almost exclusively Concords and are promptly disposed of as soon as harvested. Practically the entire crop is shipped to the markets of the United States through five or six shipping agencies having offices in Northeast, Pa. The crop of the season of 1903 placed in cars by these firms is estimated at 400 carloads of 3000-8lb. baskets per car. This is only one-half as much as the crop of the preceding year, and is regarded as only 25% of a full crop. The reason for the short crop is in great part the fact that much wood suffered from winter killing. Frequent rains during the flowering period prevented proper pollination rendering many bunches

of fruit small and imperfect. Lastly the Black Rot, at no point disastrously prevalent this year though attacking a larger number of vineyards than formerly, was a positive factor in reducing the quantity and quality of fruit of this season.

THE HISTORY OF THE BLACK ROT OF THE GRAPE.

The first alarming appearance of Black Rot as caused by the fungus *Laestadia Bidwellii* (Ell) Viala & Ravaz, in the vineyards of Northeast township in Erie county, was in 1902. At the conference with the grape growers held early in May 1903 the testimony offered did not agree upon the question of its earlier presence. The difficulty in arriving at real facts in the case is due to the fact that several fungous diseases are likely to injure the grape and the vineyardist in most instances is unable to determine which fungus occasions his loss. Mr. Z. Rogers, of Northeast, who sustained a heavy loss from Black Rot in the season of 1902 and observed closely the progress of the disease in the past season, stated that he had observed similar rotted berries in his vineyards for the past five or six years. Mr. Rogers has been growing grapes for the past 36 years and has always given his vineyards much personal attention.

In Ohio the first serious outbreak of Black Rot in vineyards occurred in 1896. It annually extended its area (chiefly westward from Ashtabula county) and became more severe in its destructive power until thousands of acres of vines have been abandoned by discouraged growers.

For more than twenty years the Black Rot fungus has been known to exist in vineyards all over the eastern half of the United States, in many places lingering unobserved until favorable conditions invite it to attack with a free hand as it were the unprotected fruit of many million vines.

The very recent experience with this disease in Ohio should be a lesson to the grape growers of the Chautauqua Grape Belt, and early steps should be taken to insure protection against a disastrous outbreak of Black Rot. In 1902 vineyards about Northeast Pa., were invaded and suffered losses ranging from 10% to 50% of their crops. It is reasonable to expect even heavier losses in the future if weather conditions are favorable to the development of the disease and accordingly preparations were made to spray several of the affected vineyards during the season of 1903.

The first appearance of Black Rot in Erie county is likely to take place sometime between the middle and last of June according to the condition of the weather. Only one familiar with the disease will be able to detect it in its early stages. Upon the leaves and young stems it manifests itself first as reddish brown spots, one-eighth to one-fourth inch in diameter. When these spots are a few days old a small magnifying glass will reveal one or more black dots near the center of the diseased area These are the pycnidial pustules of the fungus containing numerous spores for the propagation of the disease. The vine being amply supplied with foliage suffers but little injury from this attack and the vineyardist is but little alarmed by its presence. But when the fruit is involved he knows he is facing a direct loss. Sometimes the berries are attacked when quite small, causing immense destruction, but as yet in the Northeast vineyards the attack was first observed when the berries were half-grown early in July. It is not difficult to recognize the initial brown spots on green berries. This spot soon becomes sunken and with the magnifying glass one may easily observe the little black dots or *pycnidia*, as in the case of the foliage. Sometimes the berries are entirely rotted, being brown all over and retaining their plump form before any black pimples are formed. This is occasioned by the rapid development of mycelium through the tissue of the berry. When the tissue begins to collapse the berry shrivels up and turns darker becoming black and thickly beset with the pustules peculiar to the fungus. In light cases only a few berries of a bunch are attacked, but when the fungus has full sway entire bunches are rotted and every bunch on the vine is ruined.

Fig. 1 shows the prevailing condition of fruit in vineyards which were lightly touched by the disease. From 2-10 berries on a bunch are black and shriveled, marring the appearance greatly and rendering the fruit unfit for baskets. Fig. 2 shows two bunches absolutely worthless and indicates what may be expected when the disease is well established in a vineyard section and permitted to spread unmolested.

The disease is carried over winter in the shriveled black berries which are often left hanging on the vines. This being the fact the careful vineyardist will promptly dispose of the rotted berries by burn-

ing them. The illustrations do not fully portray the unsaleable condition of bunches with but two or three rotted berries. In cases of severe attack the bunches are so completely rotted that the crop is left on the vines.

DIRECTIONS FOR SPRAYING GRAPES.

In view of the fact that spores are very abundant where the disease has prevailed it is well if all prunings and weeds are removed from among the vines and burned. Before vegetation or sprouting of the buds takes place in early May the vines should be sprayed with a fungicide to catch the spores that are awaiting the opportunity to germinate and effect an entrance into new tissue.

It is important to remember that no fungicide can kill the Black Rot fungus when it has effected an entrance into the tissue of the plant or berry. The value of the remedy is wholly as a preventive.

Before the grapes come into blossom the vines should again be sprayed to protect the new growth and foliage against attack. The blossoming period extends over ten days or two weeks and no spraying should be done at this time. A film of fungicide on plants cannot be considered effectual for more than two weeks and if dashing rains intervene the period is correspondingly reduced.

After the blossoming period is completed the vines should again be sprayed, being particular to moisten all the foliage above and below as perfectly as mechanical devices and reasonable care will permit.

It is important to remember that a spore of the Black Rot fungus is exceedingly minute and if any portion of the vine is not protected by a film of the fungicide, a spore alighting on that portion may enter the tissue as easily as if no spraying had been done.

Subsequent spraying should be made at intervals of two weeks until the last of July. If no rot appears by that date, it is not probable that it will come, but if it is known to be present in the neighborhood, it will be wise to spray once more about the middle of August.

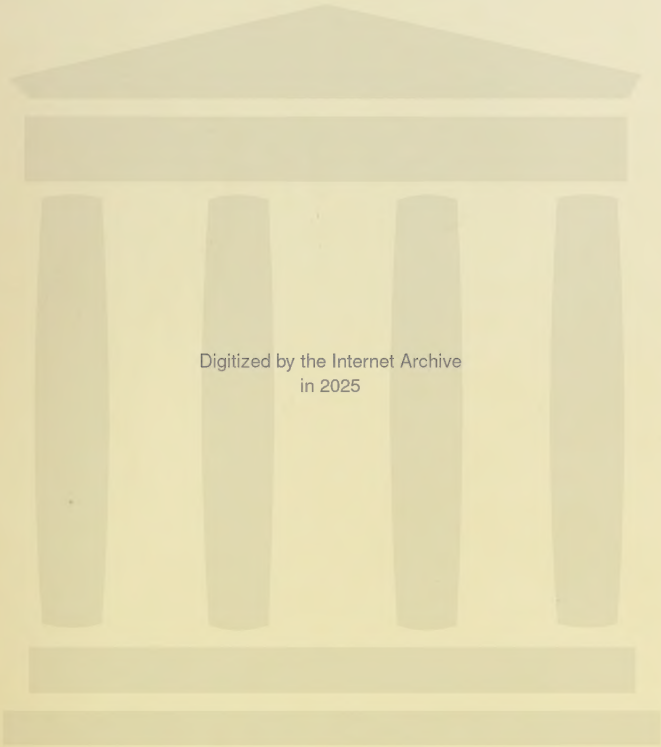
SPRAYING OPERATIONS.

It was impossible for the writer to be in the vineyard to direct operations, but two experienced vineyardists, who were not strangers to the modern methods of spraying, volunteered to spray their vineyards according to the directions of the Experiment Station officers.

One of these, Mr. A. I. Loop, has over 100 acres planted to fruits located about two miles southeast of Northeast near the southern edge of the grape belt. He has been identified with the grape industry for many years and was the first to recognize the danger which was threatening the vineyards when the rot appeared in 1902. Mr. Loop does not have a large acreage in grapes and is not wholly dependent upon the income from this fruit, nevertheless, he was not willing to lose any part of the crop if a reasonable effort could save it.

The other grape grower following our directions is Mr. Z. Rogers, whose vineyards lie about one-fourth mile west of Northeast. He harvested in 1901 a crop of 1500 baskets of grapes and in an experience of 36 years had suffered no appreciable loss of fruit because of Black Rot. In 1902 he sustained a loss of 30%—40% of his crop, and for that reason was willing to adopt measures to prevent a repetition of such a loss. Mr. Rogers proposed to spray his 25-acre vineyard and provided himself with a No. 51 Victor sprayer, made by the Fields Force Pump Co., Elmira, N. Y. This sprayer has a 50-gallon tank mounted on wheels to be drawn by two horses. The pump is geared to the wheels and is fitted to spray from four nozzles, two on either side, one set low and the other high. After trying the machine it was found that perfect spraying could not be done with stationary nozzles, and the sprayer was modified by removing the nozzles and attaching a 12-foot piece of hose, to which was fitted a cluster of 8 Vermorel nozzles so set as to direct their spray in many different directions. This cluster of nozzles was then handled by one man whose only duty was to spray one row thoroughly as the apparatus was being driven through the vineyard. In this manner the most perfect work can be done. No geared sprayer has yet given *perfect* satisfaction. The Victor sprayer when properly adjusted gives sufficient power to spray with a cluster of nozzles, and a man directing the spray can move along as fast as a horse can walk.

The sprayer used by Mr. A. I. Loop is one of his own patent devices, being placed upon the market by the Pierce-Loop Sprayer Co. of Northeast, Pa. It consists of two 50-gallon galvanized steel tanks, one for compressed air and the other for fungicide, mounted on a low two-wheeled carriage drawn by a single horse. One tank is charged with air until 140 pounds pressure is registered and the other tank is filled with Bordeaux mixture. When in the vineyard a 12-foot line



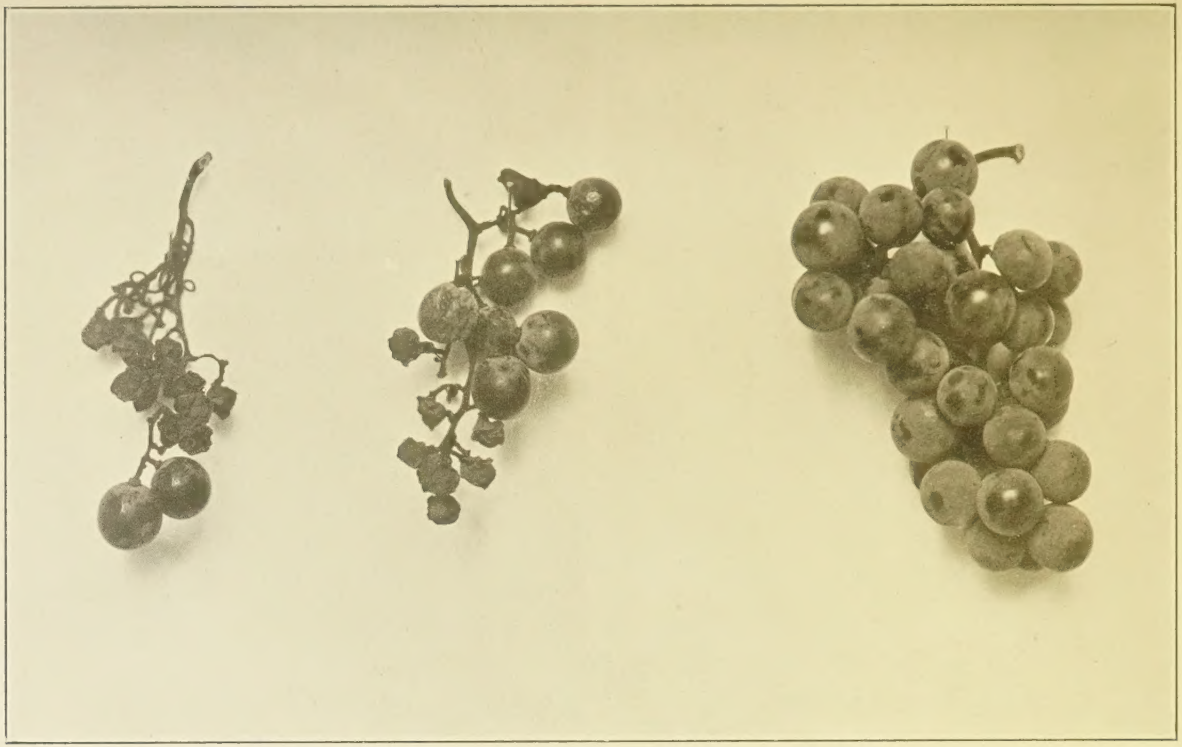


Fig. 2. **Concord Grapes.** One bunch free from Black Rot. Two bunches badly rotted, showing extreme work of destruction of crop.

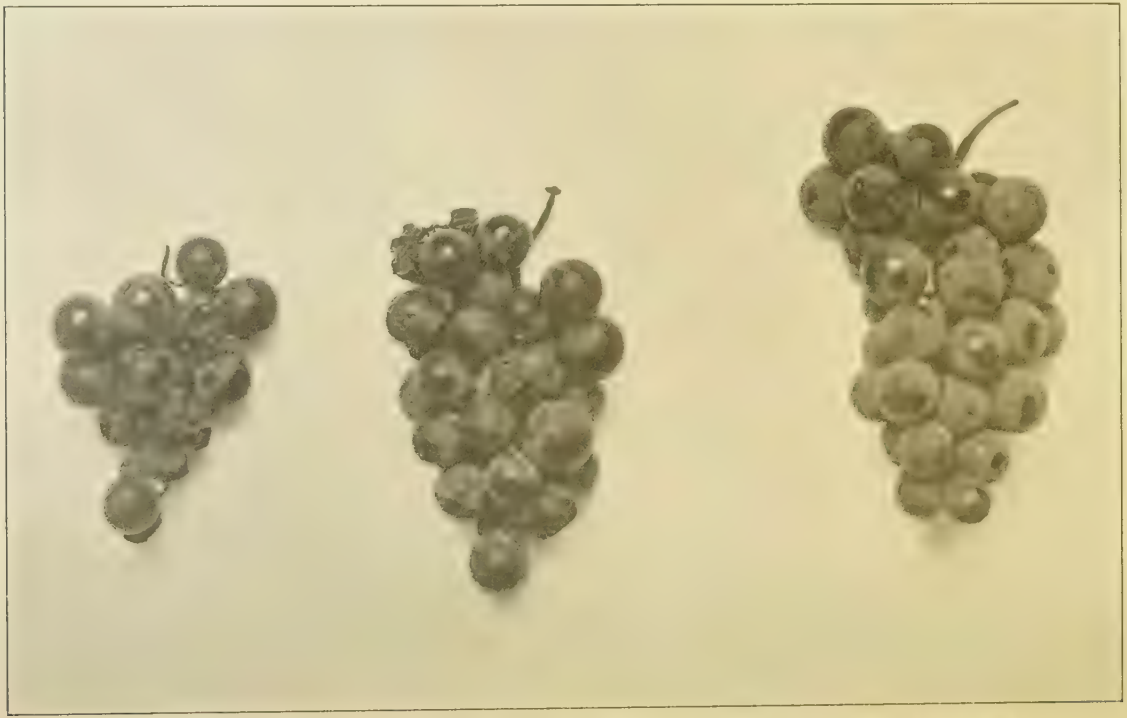


Fig. 1. **Concord Grapes.** One bunch free from Black Rot Two bunches each having a few rotted berries, but ruined for basket sales

of hose with a cluster of 9-12 nozzles is attached, and by turning a valve in a small pipe connecting between the two tanks a fine continuous spray is produced, so long as there is liquid in the machine. When exhausted the pressure in each tank is about 60-70 lbs. A valve near the nozzle can be operated by the man directing the spray at any time he desires to stop it, as when turning rows so that the liquid may be economized.

By using three such outfits, one was being charged at the charging station where a steam engine and air pump were placed, the second was being drawn from the station to the vineyard, while the third was being used among the vines; thus a continuous supply of material was provided for the man at the nozzle.

Mr. Loop reports that he used from 70 to 100 gallons of Bordeaux mixture per acre at each application which is ample for thorough spraying, and this required from 40-45 minutes per acre. Mr. Rogers reports that with his machine he could do good work and spray 10 acres per day. His water supply and mixing tank were close to his vineyard.

MR. A. I. LOOP'S REPORT.

Mr. Loop made his first application of fungicide May 26, being several days before blossoms opened. He used the 4-6 formula of Bordeaux mixture, that is 4 lbs. sulphate of copper and 6 lbs. lime to 50 gallons of water. The 4-4 formula has given good results and could have been used in this case. After the last blossoms had dropped, June 21, and in fact ever since the first week in June rains were so frequent that it was not possible to keep sufficient spray upon the vines. A second spraying was made June 29 using 3lbs. sulphate of copper to 6 lbs. of lime in the Bordeaux mixture. At this time it was apparent to Mr. Loop that he would have a very light crop of grapes. His vines evidently suffered from winter killing, some vines being killed to the ground, others making but a weak growth from the buds left in pruning. By the middle of July the rot began to make its appearance and when visiting the vineyards July 28 the writer observed the effects of the disease particularly in the "check" rows which were left unsprayed, and in a slight degree also in a few other rows.

Further spraying would have been beneficial in Mr. Loop's vine-

yard but owing to his very light crop and the pressing demands of his other large fruit interests, he discontinued the spraying of his grapes. Perfect results therefore could not be expected from two sprayings, but the figures below carefully recorded for each row of the vineyard show how well it paid to spray even two times. Each row contained 55 vines and should yield with a good crop 130 baskets of grapes.

		8 lb. baskets good.	8 lb. baskets culls.			8 lb. baskets good.	8 lb. baskets culls.
Row No 1	unsprayed	12	1	Row No 21		25	2
" " 2		10	5	" " 22		26	1
" " 3		7	6	" " 23		25	2
" " 4		20	2	" " 24		23	3
" " 5		25	2	" " 25		35	2
" " 6		46	2	" " 26		34	2
" " 7		38	3	" " 27		27	4
" " 8		25	1	" " 28		20	4
" " 9		35	4	" " 29		25	3
" " 10		32	3	" " 30		32	4
" " 11		14	1	" " 31		35	4
" " 12		18	2	" " 32		26	2
" " 13		19	1	" " 33		29	3
" " 14		22	3	" " 34		21	4
" " 15		20	1	" " 35		23	3
" " 16		20	3	" " 36		23	4
" " 17		22	2	" " 37		26	0
" " 18		16	1	" " 38		23	4
" " 19	unsprayed	16	3	" " 39		17	1
" " 20		13	9				

		Baskets good.	Baskets culls	Value
Average per row	sprayed	24.4	2.4	$3.90
	unsprayed	11.6	4.8	2.22
Gain per row sprayed				$1.68
Gain for 34 rows sprayed				$57.12
Cost of spraying				6.00
Net gain				$51.12

The value per basket was calculated at 15c. net for good fruit, and 10c. net for culls.

Record of Sprayings and Observations in A. I. Loop's Vineyard.

1903

May 4. Grape buds bursting.

" 18. Young growth 8 inches long.

" 26. FIRST SPRAYING. 4-6 Bordeaux mixture, 70 gals. per acre.

June 9. First blossoms opened.

" 21. Last blossoms fallen.

" 29. SECOND SPRAYING, 3-6 Bordeaux mixture, 100 gallons per acre.

July 29. Rot discovered.

Aug. 15. Considerable rot in unsprayed vineyards.

In Mr. Rogers' vineyard three check rows were marked to be left unsprayed. These were chosen in the middle of the 25-acre vineyard where the disease was severe the preceding year. After two sprayings had been made with due regard for the check rows, Mr. Rogers observed rot appearing on the check rows but could discover none on the sprayed rows, and, not wishing to lose the fruit on three rows, sprayed two of them at the next spraying and later sprayed all three of the rows, seeing abundant evidence of the destruction of the rot in a neighboring unsprayed vineyard.

Mr. Rogers used the 4-4 formula of Bordeaux mixture three times, May 25, June 26 and July 16, then followed with ammoniacal solution of carbonate of copper two times, Aug. 4 and Aug. 20. His observation upon this practice was that next year he will use Bordeaux mixture only two times and then follow with the ammoniacal solution three times, because the Bordeaux mixture applied late in July leaves a deposit of color upon the berries that is not wholly removed before the fruit is cut.

Record of Sprayings and Observations in Z. Rogers' Vineyards.

1903

May 4. Grape buds bursting.
" 18. Young growth 8 inches long.

June 1-2. First Spraying. Bordeaux mixture.
" 9. First blossoms opened.
" 21. Last blossoms fallen.

" 26. Second Spraying. Bordeaux mixture.
July 15. First appearance of rot.

" 16-17. Third Spraying. Bordeaux mixture.
" 28. Rot prevalent in unsprayed vineyards.

Aug. 4-5. Fourth Spraying. Ammoniacal solution.

Aug. 20-21. Fifth Spraying. Ammoniacal solution.

No figures of the crop were furnished except that the yield was 500 baskets per acre. There were no rotted fruits in the vineyard except a few upon the check rows which were not treated at the early

spraying. The most perfect results from spraying were witnessed in the vineyard. That considerable loss would have been sustained if spraying had been omitted is evidenced by the appearance of rot in the check rows and the loss of 20% to 40% in a neighboring vineyard. The fruit from this unsprayed vineyard was so badly rotted that it was gathered into crates and sold for making into wine.

Mr. Rogers reports that his crop of 5008 lb. baskets per acre sold at 18c. per basket, making an income of $90 per acre, and estimates that without spraying he would have suffered a reduction of 33 1/3% of the value of his crop or $30 per acre. He estimates the cost of spraying at $6 per acre, making his net gain $24 per acre, or from 25 acres $600.

By reference to the map of a portion of Northeast township the location of the vineyards of Mr. Z. Rogers and Mr. N. H. Clark together with certain unsprayed vineyards is clearly represented.

STATEMENT OF N. H. CLARK.

Mr. N. H. Clark of Northeast, Pa., has 25 acres of grapes just a few rods south of Mr. Z. Rogers. He sprayed during the season of 1903 having also suffered a loss from rot in 1902. In order to bring together in this bulletin all the available experience in spraying Mr. Clark was requested to prepare a statement of his work and the results which followed. His statement is as follows:—

> "The first spraying was done as soon as the vineyard was tied up and before the buds started, using the 4-4 Bordeaux formula, that is 4 lbs. of lime and 4 lbs. of vitriol to 50 gallons of water.
>
> "The second spraying, June 10, just before the grapes came into blossom using the 4-4 Bordeaux formula and adding 4 ounces of arsenic—sal soda solution—to 50 gallons of water.
>
> "The third spraying, June 29, as soon as the fruit set, using the same mixture as for the second spraying.
>
> "The fourth spraying, July 16, using the 4-4 Bordeaux formula.
>
> "The fifth spraying, Aug. 4, using the weak vitriol solution—1 lb. blue vitriol to 200 gallons of water.
>
> "The sixth and last spraying, Aug: 24, using the weak vitriol solution same as for the fifth spraying.
>
> "At the first spraying we used 50 gallons to the acre and at the last five sprayings we used 75 gallons per acre. The weak vitriol solution seemed to be fully as effectual as

the soda-Bordeaux or ammonia solution and is easier to handle and not so expensive.

"In the year 1902 we lost fully one-third of the crop by Black Rot and the stems of the fruit were badly affected by mildew. After following the above treatment during the year 1903 it was very hard to find any indication of the Black Rot on either the fruit or foliage, and the stems of the fruit were free from mildew, while adjoining vineyards were badly affected by Black Rot and mildew on the stems.

"In my estimation there are two very essential points to observe in successful spraying: first, to have the Bordeaux mixture properly made, that is to have the lime and vitriol thoroughly mixed; second, to apply the mixture in a fine, penetrating mist-like spray.

"The day before spraying we put 50 gallons of water in a barrel and suspended 100 lbs. of blue vitriol in a coarse sack in it. In from 12 to 14 hours the vitriol will dissolve making a stock solution that each gallon of water would contain two pounds of vitriol. The lime used was a prepared lime that did not require slacking. To make the Bordeaux mixture we weighed out four lbs. of lime in a pail, filled the pail about three-quarters full of water, stirred it thoroughly and then strained it into the sprayer tank. This tank was then nearly filled with water and two gallons of the vitriol stock solution was added and thoroughly stirred. The tank was then filled with water and was ready for use. I think the prepared lime is fully as good as that requiring slacking and saves time.

"The entire cost of material for spraying 25 acres six times was $38.85. The machine used was a 50-gallon, one-horse vineyard rig made by E. C. Brown & Co., Rochester, N. Y. It gave splendid satisfaction and could easily spray 10 acres a day."

Northeast, Pa., Dec. 5, 1903." N. H. CLARK.

This statement is in full accord with the experience in Mr. Rogers' vineyard. The Horticulturist of the Experiment Station made observations in Mr. Clark's vineyards during the season and witnessed the spraying on several occasions. Mr. H. H. Harper, who conducted the work for Mr. Clark, is a keen observer and fully realizes what is proper and thorough spraying.

STATEMENT OF CRAWFORD BROS.

Crawford Bros. of Northeast, Pa., have 50 acres in grapes and having sustained a loss from Black Rot in 1902, they made preparations early in the spring of 1903 to spray their vines. They used the Pierce-Loop sprayer and have been much pleased with the results at

the close of the season. Under date of November 20, 1903, they wrote in response to a request for a statement as follows :—

> "Replying to yours of the 13th, inst. we have had, we think, on our vineyards this past season the heaviest crop of grapes in this section, and we attribute it largely to the spraying we have given them. Owing to a delay in getting our outfit together we were not able to begin operations until the leaves were about the size of silver dollars, after which time we sprayed thoroughly with Bordeaux mixture, going over them about every week or ten days until the fruit was one-half grown. Then we substituted the weak sulphate solution (1 lb. sulphate of copper to 200 gallons of water), This we continued until near picking time, As a result we had as fine fruit as we ever grew, absolutely free from rot or other fungus disease.
>
> "We also found that they stood shipment far better than the unsprayed fruit.
>
> "In using the weak sulphate solution we gradually increased the strength to 3 lbs. to 200 gallons of water which we used toward the last without injury to the fruit or foliage. Respectfully yours,"
>
> CRAWFORD BROS.

Crawford Bros. Co. of Northeast, Pa., are large shippers of fruit and produce, and therefore had excellent opportunity to see the condition of much of the grape crop marketed from the Northeast grape region. They have been so enthusiastic over their success in spraying that they remarked to a neighbor vineyardist that they considered their season's spraying as worth $3000 to them. Upon being asked the basis for this estimate and whether they would permit its publication, they replied under date of November 27, 1903, as follows :—

> "GEO. C. BUTZ,
>
> "Dear Sir :—Replying to yours of the 23rd, inst. we have fifty-five acres in grapes and sprayed them all with the exception of about one-fourth acre, where the ends of the rows would not allow of our turning with the carts. This is the only thing we have to compare with except our neighbors vineyards which rotted more or less. The young fruits dropped badly when just nicely set (or about the size of buckshot). This dropping we avoided on our vineyards largely, we think, by the spraying. *We had no rot at all* except on those we did not spray as mentioned above, where we lost perhaps 10%.
>
> "The general condition of our fruit was much better

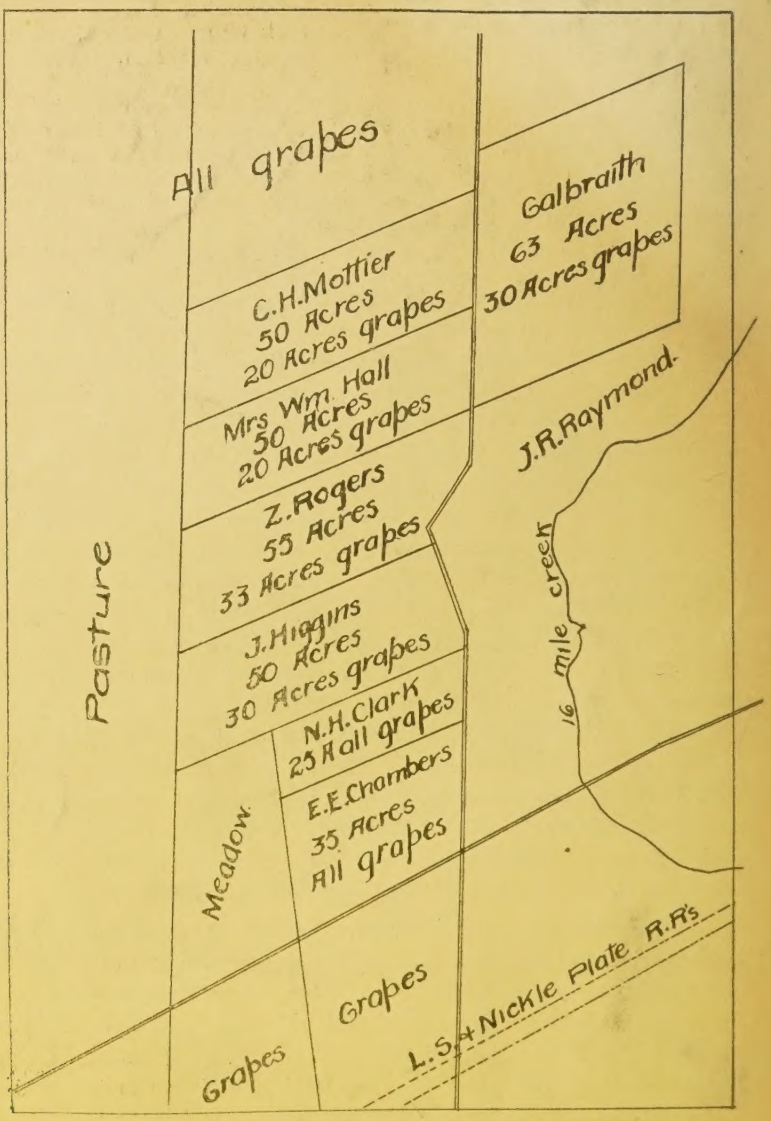
this year than last. On a 2-acre vineyard of Niagara in 1901 and 1902 we lost 50% by rot (this was the worst piece we had). The same piece this year under spraying was perfect.

"Regarding the financial value of our spraying this year, we see no reason to recall our statement that it has benefited us to the extent of $3000. Of course we have 30 acres of other fruit on which we were benefited, but we would not withhold the spraying from our vineyards for the season of 1904 for that amount. Yours truly,"

CRAWFORD BROS.

This is strong testimony in favor of spraying with Bordeaux mixture and should convince every vineyardist who has suffered loss from rots that he should make prompt preparations for spraying. When failure to protect grapes by spraying is reported it is very probable that the formula used or the style of sprayer or the amount of material applied is faulty. A notable case of this kind in Erie county was discovered by the writer. A grape grower with many acres had suffered heavy losses from rot several seasons and had sprayed with Bordeaux mixture through two years without beneficial results. When we proposed directions for spraying with Bordeaux mixture (4 lbs. blue vitriol and 4 lb. lime to 50 gallons of water) he replied that if there is nothing better to use he did not care to spray again. Upon inquiry it was found that this grape grower had been using a Bordeaux mixture of 16 lbs. of blue vitriol and 22 lbs. of lime to 60 gallons of water, a mixture so concentrated that it could not be sprayed in a fog, but it left the nozzle in heavy drops and of course merely *spotted* the foliage of the vines. This it is plainly seen is no protection against the minute spores that may lodge anywhere upon the leaves or fruit. In this case also the sprayer was incapable of doing perfect work and all the time and material used were a useless expense

It is certain that many vineyardists will spray next season having been convinced of the value of it too late to have engaged in the work for the crop of 1903. Mr. W. S. Wheeler of Northeast, is one of this number. He writes under date of Dec. 10, 1903, "I did not spray as I expected. I was disappointed with my spraying outfit. I can plainly see I suffered a loss by not spraying. Not so much rot as wormy grapes. I will spray everything next year."



Map of Vineyards where part of the spraying operations were conducted being a part of Northeast Township one-fourth mile from Northeast Borough.